GLOBALISATION AND THE PRO-POOR GROWTH: DEVELOPING A WIN WIN STRATEGY

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Abstract:

In this paper we investigate the effects of the most frequent mode of globalisation -- the import liberalisation -- of a representative South Asian developing economy of Nepal using general equilibrium model. Our results show that tariff reduction is growth enhancing but the rich benefit more than the poor. We make a restructured but plausible model economy with due consideration of 10 years of gestation period and simulate the same experiment of import liberalisation in the context of dynamic model. We conclude that improvement in efficiency parameters, upgrade of labour by skill category, and reallocation of factor endowments by household groups and activity types, more specifically poor household groups towards faster growing sectors of the economy, can make the growth accrued by import liberalisation pro-poor.

Key words: import liberalisation, CGE model, poverty, pro-poor growth, economic restructuring
JEL classifications: O24, D58, F43, I30, J31

1. Introduction

Many developing countries have undergone with economic transformation basically with trade liberalisation under the structural adjustment programme during the last two decades. In this respect, the traditional trade theory that excludes, by assumption, uncertainty and unemployment should be reassured. Most importantly, the most celebrated Stolper-Samuelson theorem needs review from the viewpoint whether a skill-poor developing country after opening up to international competition will grow more and experience a reduction in factor income inequality.

In addition to the structural adjustment programme of the IMF and the World Bank, the move towards the import liberalisation by developing countries has different reasons. de Melo et al. (1992) have

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rightly remarked that import liberalisation in developing countries is a move towards getting the GATT (WTO) membership. Edwards and Lederman (1998) consider import liberalisation essential for the trade diversion of developing countries as evident from the experience of Chile. Some consider it as a strategic move by a country to promote regional freer trade, see Bhagwati (1990), McLaren (1997, 1999), and Krishna and Mitra (2003).

During the last decade, a number of empirical works have resorted to see whether the predicted gains from trade liberalisation have materialised. Most of these studies find that trade reform is accompanied by productivity growth, technological advancement, falling mark-ups and a reshuffling of resources toward more efficient firms; although in some cases the evidences fail to confirm these results. Traditional trade theory supports the allocation efficiency argument for freer trade in the context of perfectly competitive markets. Since the late 1970s, however, the emerging new trade theory has shown that the gains from trade originating from specialisation according to the comparative advantage are only parts of the story; since even in the presence of imperfectly competitive markets, trade liberalisation can also bring additional gains by reducing the deadweight losses created by domestic firms' protected market power. In particular, it forces firms to lower price-marginal cost, and mark-ups, thereby raise firm size and scale efficiency. These all ultimately help an economy grow faster, Efipani (2003), p.2. Recently, it was also shown that in the presence of within-industry firm heterogeneity, trade liberalisation causes more productive firms to expand at the expense of less efficient firms which either shrink or exit, thereby it induces additional efficiency gains. Moreover, trade and investment liberalisation may foster technology improvement and productivity growth in developing countries through several channels.

In a different strand of thought, the main argument against trade reform in developing countries opts for an import substitution industrialization strategy to prevent exacerbation of income inequality and hence deterioration of the conditions of the poor. In particular, these concerns regard higher unemployment among workers displaced from the contracting import competing sectors, greater uncertainty and precariousness of job conditions, and the creation of new job opportunities only for the most qualified segments of the workforce as inevitable consequences of import liberalisation. Moreover, some also argue dramatic increase in wage inequality. Recent theoretical and empirical literature can explain that in the presence of imperfect competitive markets, increasing returns to scale, and heterogeneous firms, trade liberalisation can indeed exacerbate wage inequality even in a skill-poor developing country, Harrison and Hanson (1999). Moreover, they also put evidence on small impact on employment. Matusz and Tarr (1999), and Bacchetta and Jansen (2001) show high adjustment costs and small benefits from import liberalisation in the developing world.

Plant-level evidence, however, reveals slightly different results that trade reforms in developing countries do not generally bring a sharp contraction of import competing skill-intensive sectors rather they are associated with a greater wage volatility and a greater investment in technology and human capital. Trade models based on increasing returns to scale and imperfect competitive markets, too, can generally explain this evidence. Few studies used a two-step computationally simple procedure to analyse the effects of unilateral tariff liberalisation. Ianchovichina, Nicita and Soloaga (2001) modelled the effects of price changes on poverty and income distribution following the tariff reform of Mexico as a salient feature of its membership to the North American Free Trade Agreement (NAFTA). The impact of tariff reform on welfare would be positive in general for all expenditure deciles. Moreover, when non-homothetic individual preferences were modelled, trade liberalisation had a good prospect of benefiting people in the poorer deciles more than those in the richer ones.

The complete removal of tariff increases all imports and the export-oriented sectors are also favoured in Zimbabwe, Chitiga, Kandiero, and Mabugu (2005), pp. 20-21. According to their CGE model, trade liberalisation benefits the unskilled labour used intensively in agriculture, mining and services but most of the manufacturing sectors shrink leading to a fall in demand for skilled labour and capital. Overall consumer prices as well consumption expenditure fall. Reduction of poverty is more in urban than in rural areas and in overall the income distribution pattern hardly changes. However, Corroraton (2003) concludes with worsening income distribution in the Philippines despite the reduction in poverty following the complete tariff removal.

To summarise, review of the substantial empirical research during the past two decades does not lead us to a robust conclusion regarding the distributional impact of import liberalisation. Moreover, the combinations of complex but partial phenomena, choice of variables, and data inadequacies have rendered the empirical works both hazardous and partial. In-depth country-specific studies, especially using the general system approach, might be more insightful in this regard. It allows the study incorporate more facets of import liberalisation-cum-distribution phenomena in a constrained framework for the whole economy and makes it possible to appraise alternative policy paths towards achieving pro-poor growth under trade openness. This study attempts to fulfil this need. In this context, the objectives of this paper are two-fold. First, it measures the impacts of import liberalisation to a small open economy of Nepal in a general equilibrium framework. Second, in the absence of pro-poor growth, it presents the mode of restructuring the economy and tests whether those restructuring measures could generate pro-poor growth.

The remainder of this paper is as follows. Section 2 formulates a general equilibrium model to the Nepalese economy followed by the simulation analysis of import liberalisation in Section 3. Section 4

presents the specific modes of economic restructuring to Nepal from the perspective that these will be conducive to the pro-poor growth under import liberalisation to this typical South Asian village economy. Section 5 again repeats the simulation but under the restructured economy. Section 6 concludes whether the modes of restructurings are conducive to the pro-poor growth under import liberalisation to a developing economy such as Nepal.

2. The model

2.1. Nepal CGE model

Our model is specified in 30 equational sets, divided into four blocks for prices, production and commodities, institutions, and system constraints. Notations used and model specifications are displayed in the Appendix. The model contains four activities and four corresponding commodity types [agriculture (AGR), industry (IND), commercial services (CS), and other services (OS)], three factors of production [low skilled labour (LSL), high skilled labour (HSL), capital (CAP)] and four household groups (U-HH, LR-HH, SR-HH, LLR-HH).[1] Appendix A2 presents all the notations used in the model. Here we present a brief outline for each block of equations.

Prices

We use four different types of prices of commodities; they are import and export prices prevailed at international market, activity prices applicable at the domestic production levels, domestic supply prices of domestic productions inclusive of indirect taxes, and composite prices of commodities inclusive of domestic productions and imports. We measure the Consumer's Price Index (CPI) after each simulation to get an overview of the overall price movement. We use composite prices of commodities to calculate the CPI index.

Production and commodities

We use Cobb-Douglas production function for four activities – agriculture, industry, commercial services, and other services[2] – for two reasons. First, in the absence of rapid economic transformation, relative shares of factor composition in activities do not fluctuate much so that the assumption of fixed proportions of factor composition in production is logical. Second, this production function provides robust results in various policy analyses as compared to other production functions when factor shares are too disproportionate among activities. For Nepal, as evident from Table A2.3 in Appendix, wage bills for high skilled labour in agricultural activities is almost 6 times less as

[1] This sub-division of households is based on various socio-economic characteristics, regional attributes and other endowment characteristics applicable to Nepal. The first two groups (Urban Households, U-HH, and Large Rural Households, LR-HH) are rich households whereas Small Rural Households (SR-HH), and Landless Rural Households (LLR-HH) are poor with LLR-HH being poorest.

[2] It refers to public services.

compared to that of low-skilled labour as well as that of the capital employed in this activity. Likewise, in industrial sector, more than 60% of the value added goes to a single factor – the capital. Contrary to this, less than 7% of the total value added in public services goes to capital and the rest to labours. Some other studies, for example, Felipe and Holz (2001), have also followed Cobb-Douglas production function to different activities for the same reasons.

Our CGE model belongs to the neo-classical group. However, there are some major differences of this model with other CGE models. Firstly, we have explicitly used import and export elasticity coefficients in the model, which are often overlooked by many modellers. Secondly, we have avoided the possibility of including double taxes in commodity markets, which is also a major problem in many CGE models. Thirdly, this model has divided the whole household groups into poor and non-poor groups as mentioned above; it helps the readers in observing the results from the viewpoint of pro-poor growth.

Institutions

This Nepal CGE model has three institution accounts: households, firms, and the government. Households have factor income from activities, and transfer income from government and the rest of the worlds. Likewise, household expenditure consists of consumption expenditure --- distributed into four commodity types --- and the tax to the government. The balance between income and expenditure of households goes to national saving. Households and firms have fixed marginal propensities to save. However, contrary to the household sector, firm's income only consists of profits from its investment in industrial activities and commercial services. Firm's disposable income is fully invested.

Government revenue is collected basically from import tariff applied as ad valorem tax, direct tax to the households in a fixed rate to their total income, and net transfer income from the rest of the world. Export tax is virtually absent in Nepal. Likewise, government expenditure consists of consumption expenditure, and transfer to households. The balance between revenue and expenditure goes to national saving.

System constraints

We have three types of system constraints in our model: factor constraint, commodity constraint, and saving-investment constraint. Our model is a static one; therefore, total factors in the economy are exogenous but they can reallocate across activities. Total commodity supply balances to its total demand in the economy. The composite supply of a commodity consists of its domestic supply and import. Likewise, total household demand, government demand, and investment demand constitute the total domestic demand of a commodity. The balance between total domestic demand and supply

makes stock change. The stock change applies to agricultural and industrial commodities but not to services. The saving-investment constraint makes total saving ---constituted from total domestic institutional saving and foreign saving --- and total investment equal. The foreign saving comes as a balance between total import and total export plus net transfer income from abroad. The saving investment balance in both baseline and simulations are confirmed with the value of Walras that must equal to zero in both cases.

See Appendix A2 for all the model equations and the definitions of the parameters used in the model. A short explanation, see Section 2.2, will suffice how this model differs from other neo-classical models. For detail description of the model, see Acharya (2006), chapter 4.

2.2. Improving the flexibility in the neo-classical model

Using import calibration constant (im_c), and import elasticity coefficient (ime_c), equation 13 in the Appendix specifies how the domestic price (PD_c) to import price (PM_c) ratio determines import (QM_c) to domestic demand (QD_c) ratio. Similar specification to exportable is given in equation 15, where eec_c is the export elasticity coefficient. In this equation, QE_c and QD_c respectively refer to the quantity of export and domestic supply of commodity c; and PE_c and PD_c their prices. See also Appendix A1 for the definitions of parameters. Incorporation of the import and export elasticity coefficients has provided enough flexibility for fine tuning the model with respect to the policy simulations pertinent to the import and export liberalisations.

The model elaborates on gross fixed capital formation (GFCF). We introduce the two coefficients ε_0 and μ in the second part of equation 21, whose values determine whether there is crowding-in or crowding-out effect of government investment (GI) on private investment. Moreover, the model is fully able to incorporate the investment elasticity of profit rate change, coefficient ϕ in equation 21. The flexible composite prices clear the commodity markets whereas the flexible factor prices clear the factor markets. The nominal exchange rate has been made exogenous in the model.

Our model, furthermore, applies the detailed distribution of factor incomes; it is by household, factor, and activity types, represented by subscript h, f, and a, respectively, in equation 17. This three way classification of factor incomes makes it possible to link changes in outputs/activities to changes in factor and household incomes. See Appendix Table A2.1 for the distributional share of factor incomes.

2.3. The rule of closure

The neo-classical Nepal CGE model which we formulated has four market closures: government balance closure, factor market closure, foreign exchange closure, and saving-investment closure. Tax

rates are fixed whereas government revenue and expenditure are flexible in government balance. In factor market, total factor supplies are fixed whereas returns to factors are flexible. Likewise, in external balance, nominal exchange rate is fixed whereas foreign savings is flexible. Lastly, for saving-investment balance, the average propensities to save (*aps)* of non-government institutions are fixed and the level of capital formation is flexible.

Our model counts 158 single variables in 128 single equations. For the unique solution, 30 variables required to be exogenous. We choose them as factor supplies (QFS_f,), total population (*TPN*), nominal exchange rate (*EXR)*, world market prices of exportable and importable *(*PWE_c, and PWM_c*)*, government consumption (GC_c*)*, export of public services *(*$QE_{os\text{-}c}$*)* that is virtually absent for Nepal, government investment (*GI)*, and transfer from one to another institution *(*TR_{hr}, TR_{hg}, TR_{gr}, and $TR_{fi,g}$*)*; see Appendix A1 for the details of these variables. Finally, we select domestic price of domestic industrial commodities ($PD_{ind\text{-}c}$*)* as a numeraire. The choice of the numeraire to $PD_{ind\text{-}c}$ is attributed to the fact that it fluctuates within a very narrow range as compared to other price variables because industrial imports share a big proportion to the total imports in Nepal –-- almost half of the non-competitive imports and more than one third of the competitive imports. In the competitive market, therefore, domestic industrial products do not have much price freedom; they are almost equal to the world prices of the industrial products which we consider exogenous in our model because of the small country assumption. Following all these adjustments, the number of endogenous variables and single equations both became 128 in our model to produce unique solution to the policy simulations.

3. Policy simulations

The CGE model is solved to give baseline values of the model variables that correspond to their observed levels for 1996. In the 1996 baseline values, all activity prices, PA, are made equal to 1.0 and other price variables are adjusted accordingly. Likewise, all quantity variables are expressed as the division of their expenditure values by corresponding price index. Furthermore, variables such as total consumption expenditure, investment expenditure, domestic savings, foreign savings, government revenue and expenditure, GDP, distribution of factor income, and households as well as corporate income are all consistent with government statistics to the year 1996. In our model, we call all these values as the baseline values which constitute the Social Accounting Matrix (SAM) of Nepal, see Appendix A1 for macro and broadly disaggregated Nepal SAM 1996. The baseline values reproduce Nepal SAM 1996 in the process of model calibration. Moreover, model parameters are also fully consistent with these baseline values.

Since January 2005, Nepal has become the member of WTO. Therefore, it has to lower the custom tariff gradually and reach the minimum rates within a couple of decades. Moreover, Nepal is also a member of South Asia Free Trade Agreement (SAFTA); therefore, it has to eliminate custom duties in major consumer goods for promoting the free regional trade. This is the major part of the globalisation of Nepalese economy. In this section, we test the impacts of import liberalisation on commodity market, factor market, institutional income, public budget and the foreign sector.

Here we implement a simulation with the reduction of import duties by 10%. The immediate effect of this import liberalisation is that the import prices (PM) of all commodities go down (Table 1). This movement also pushes the composite prices (PQ) of these variables downwards because imports and domestic supplies constitute the composite markets of commodities. The composite price of agricultural commodities, however, moves slightly upward that is attributed to two factors. Firstly, agricultural competitive market contains a very limited share of import (6%) as compared to the import shares in other composite supplies (about 11% for industrial goods and commercial services and 24% for public services) as shown by Nepal SAM 1996.[3] Therefore, tariff reduction does not influence much to the composite price of agricultural commodities. Secondly, the fast growth of industrial sector in this scenario (Table 2) pushes the composite price of agricultural commodities upward because these two sectors have strong input output relation for Nepal (Appendix Table A2.3).

Export prices (PE) do not change because of the world market prices (PWE) which are made exogenous in our model under the small country assumption. Moreover, we have also treated the rate of exchange (EXR) as an exogenous variable in the model. Producers' prices of domestic commodities (PX) move in the same direction and are practically equal to the supply prices of domestic commodities (PD). Activities prices (PA) are completely determined by producers' prices (see equations 3, 4, and 5 in the Appendix A1). Therefore, we confine ourselves to the analysis of activities' price changes from this group of three price indices. The explanation equally covers to other two as well.

The import liberalisation has a moderating effect on the activity price for industry by maintaining the price at the same level, while other activity prices (PA) move upward. The rise in price level of these activities is caused by a supply of goods that increases at a lower pace than the demand, partly caused by a shift of resources to industry from these sectors (Table 4).

Value added price is the activity price less domestic and imported intermediate deliveries per unit of activity (equation 6, Appendix A1). Because of the positive relationship with the activity price, the

[3] See Acharya (2007) for Nepal SAM 1996.

value added prices also rise-up in all the activities (Table 1).

Table 1: Baseline and simulated price indices of commodities and activities

Sectors	Baseline values				Simulated values			
	PM	PQ	PA	PVA	PM	PQ	PA	PVA
Agri	1.13	1.015	1.0	0.725	1.119	1.019	1.005	0.729
Ind	1.10	1.042	1.0	0.411	1.092	1.027	1.000	0.413
ComSer	1.15	1.021	1.0	0.678	1.131	1.017	1.002	0.682
OthSer	1.20	1.019	1.0	0.626	1.183	1.015	1.002	0.631

Note: Agri, Ind, ComSer, and OthSer refer to agriculture, industry, commercial services, and other services, respectively.

The import liberalisation causes differential impacts on commodity markets in terms of production and supply. Because of the faster decline in composite price of industrial commodities as compared to others (Table 1), industrial activity grows more than other activities. Moreover, Nepalese industries are highly agro-based; therefore, the industrial growth is only possible with an expansionary agriculture. These are the reasons of the growth of industrial activities followed by agricultural activities (QA) in the import liberalisation. The import of industrial commodities increases fastest, followed by that of agricultural commodities; whereas in case of services, imports decline (Table 2). The highest growth of industrial imports in import liberalisation is because of the highest import elasticity coefficient in Nepal CGE model, ime_c in equation 12 at Appendix A1.[4] On the other side, one may inquire why both commercial and public services are imported less following the import liberalisation despite the decline in import prices. Because of the decline in domestic activities of services (QA), which we will explain later, the intermediate domestic demands of services also decline and they go to final consumption instead, which makes it plausible for the imports to decline despite the lower import prices.

The growth/contraction in the domestic activities by sector (QA) has proportional impacts on the domestic supply of domestic commodities (QD), supply of composite commodities (QQ), and commodity exports (QE). More specifically, high growth of domestic production, supply, import and export are all apparent in the case of industrial commodities -- all these quantities grow by more than 2.5% as compared to agricultural commodities where they grow by less than 1%. These differences in growth rates of industrial and agricultural products are due to the differences in the use of intermediate deliveries both from domestic and imports. Furthermore, Table 2 shows QD, QQ, and QE to decline by about 3% for commercial services and by about 1% for public services because of the overall decline in QA in services.

[4] In our model, ime_c for industrial commodities is 0.6; whereas for other commodity markets it is about 0.2.

Table 2: Baseline and simulated quantities by commodity and activity (values in billion Rupees)

Sectors	Baseline values					Simulated values				
	QM	QE	QQ	QD	QA	QM	QE	QQ	QD	QA
Agri	8.1	5.8	128.3	119.2	125.0	8.2	5.8	129.5	120.2	126.0
Ind	16.5	33.7	105.6	86.7	120.4	17.0	34.6	108.4	88.9	123.5
ComSer	12.7	15.9	98.8	84.2	100.1	12.4	15.5	96.1	81.8	97.3
OthSer	13.3	-	53.8	38.1	38.1	13.2	-	53.5	37.8	37.8

The net effect of the growth in agricultural and industrial activities and the contraction in services is positive as revealed by the growth in GDP (Table 3). The simulated values show that consumption demand of all household types' increases (Table 3) due to the growth in household incomes (Table 5). Gross Fixed Capital Formation (GFCF) and change in stock (CHST) (Table 3) constitute investment demand. Here, GFCF grows faster over the composite supply (QQ) leading to the decline in CHST.

The import liberalisation leads to a minimal change in the foreign savings. Having in mind that the exchange rate is fixed, foreign savings increase by 0.86% (Table 3). The reason behind this inflow of more foreign capital is the growth of import faster than the export (Table 2). In this situation, the foreign exchange balance could only be possible with the increased foreign capital inflow.

Table 3: Gross domestic product, investment and change in stocks (values in million Rupees)

	Baseline values	Simulated values
GDP (at factor cost)[5]	231901.0	233238.0 (0.58)
Total consumption	214487.3	215570.3 (0.50)
Households	191469.3	192639.3 (0.61)
Government	23018.0	22931.0 (-0.38)
Gross Fixed Capital Formation (GFCF)	56081.0	56262.3 (0.32)
Change in Stock (CHST)	11937.0	9735.6 (-18.44)
Foreign Savings (FSAV) (in foreign currency, million)	24299.0	24506.8 (0.86)

Note: Values in the parentheses are the percentage growth rates from the baseline.

Factor reallocations among sectors follow patterns consistent with growth by sectors. The growing sectors absorb more factors whereas the contracting sectors lose them. Regarding the rates of factor remunerations, they all increase due to the overall growth in the economic activities. However, the rate of factor remuneration to capital rises more to labour (Table 4) because of the more capital intensive mode of industrial production which is undergoing faster expansion in this import liberalisation policy. As factors are considered fully mobile and homogenous across all sectors, the changes in wages and profit apply to all sectors in the economy.

Now we turn to the results on incomes by institutions. The total factor income grows by 3.1% in the industrial sector, 1.4% in the agricultural sector and 0.2% in the public services; whereas it declines by 2.2% in the commercial services (Table 4). As the larger share of the agricultural value added in

[5] Here, GDP figure is at factor cost as per our model formulation; therefore, it does not match with the column totals in this table that give GDP at producers' prices.

the form of wage to labour and rent to the land go to the wealthier landlords, the large rural households (LR-HH) in our model, they become the most beneficiary under this policy of import liberalisation (Table 5) (See also Appendix Table A3.1 which shows how the household groups draw their factor income across activities). It is shown from Table 5 that LR-HH income grows by 0.7%. For urban households (U-HH) it grows by lowest rate (0.52%) because this household type draws its income mostly from services then from industries, while the former is undergoing contraction in import liberalisation. But the combined effect of the returns from agriculture and industry is more than services so the net effect is still positive even to this household group. The Small rural households (SR-HH) and land-less rural households (LLR-HH) benefit slightly more than the urban household group because of their high dependence on agriculture, which is growing. Overall, growth rate of LLR-HH income is almost equal to the national average growth rate (Table 5).

Table 4: Baseline and simulated values in factor markets

	Baseline levels	Simulated values	Total remuneration of factors in baseline= (W_f) . (QF_{fa})	Total remuneration of factors in simulation= (W_f) . (QF_{fa})
Wages in Rupees and profit rate				
W_f (LSL)	8068.8	8119.5		
W_f (HSL)	15255.2	15384.3		
W_f (CAP)	0.207	0.208		
QF_{fa} *Factor use by activity(labour in millions, capital in mln Rupees)*				
LSL-AGR	4.946	4.985	39905.0	40478.6
LSL-IND	1.265	1.296	10204.0	10522.4
LSL-CS	2.167	2.105	17482.0	17091.9
LSL-OS	1.566	1.557	12637.0	12639.6
HSL-AGR	0.498	0.501	7599.0	7708.2
HSL-IND	0.577	0.59	8809.0	9083.8
HSL-CS	0.354	0.344	5407.0	5286.4
HSL-OS	0.627	0.622	9565.0	9567.0
CAP-AGR	207860.4	209858.8	43129.0	43748.9
CAP-IND	146961.1	150835.0	30493.0	31444.3
CAP-CS	216974.0	211137.4	45020.0	44015.5
CAP-OS	7957.0	7921.3	1651.0	1651.3

Note: W_f(LSL) refers wage rate (W_f) of low-skilled labour (LSL). LSL-AGR refers total number of low-skilled labour (LSL) in agriculture (AGR). Similar interpretations apply to other abbreviations also. Please also see Appendix A1.

Overall, we see the reduction of poverty as all household groups have higher income following the import liberalisation but there is no clear sign of reduction in inequality as one of the richest household groups is the most beneficiary while the poor household groups are in the middle in terms of the growth in household income. Corporate income, however, declines due to the contraction of

commercial services.

Table 5: Impact on household and firm's income (values in million Rupees)

Household and firms' income	Baseline values	Simulated values	Growth rates (in %)
Urban households, YH(U-HH)	69869.0	70229.2	0.52
Large rural households, YH(LR-HH)	49367.0	49712.0	0.70
Small rural households, YH(SR-HH)	65488.0	65915.8	0.65
Landless rural households, YH(LLR-HH)	37856.0	38094.4	0.63
Per capita in come of LLR-HH, PCI_{LLR-HH}	4005.2	4030.4	0.63
Per capita income of Nepal, PCI(N)	10690.7	10756.6	0.62
Firms' income (YFIR)	22463.0	22339.1	-0.55

Another major impact of import liberalisation is on the government budget. Currently, custom duties comprise almost one-third of the government revenue in Nepal; scaling down the import duties by 10% reduces the total revenue by about 7.6%. As there is only insignificant decline in expenditure, budget deficit widens by almost 22% (Table 6).

Table 6: Impact on government variables (values in million Rupees)

	Baseline values	Simulated values
Government revenue (GY)	32718.0	30235.4 (-7.59)
Government expenditure (GE)	43629.0	43542.0 (-0.20)
Budget surplus/deficit (GS)	-10911.0	-13306.6 (21.96)

Note: Figures in the parentheses are the percentage growths from the baseline.

To conclude, the import liberalisation policy has shown a reallocation of factors among the sectors that brings a higher overall GDP and that benefits poor and rich groups, the latter slightly more. But the government deficit is also bound to increase with likely undesirable effects for long run inflation.

4. Restructuring the economy in favour of the poor

The import liberalisation policy simulated to the Nepalese economy does not reveal pro-poor growth despite the expansion of economic activities. Therefore, we propose the following modes of restructuring the economy and test whether these measures could generate pro-poor growth under import liberalisation. Here, we simulate the policy with long-term and dynamic prospect of the Nepalese economy. Therefore, our CGE analysis from now onward is in the context of dynamic model. Nepal CGE model has the following assumptions while converting static into dynamic recursive model:

i. The static model was solved for the base year 1996; the dynamic model is solved for the 10th year, 2006, assuming the constant average annual growth rates in different sub-accounts throughout the period.

ii. Factors are homogenous and mobile across activities similar to the static model.

iii. Investment is savings-driven. Capital stock growth is endogenous.

iv. Growth rate in labour force is exogenous. However, labour reallocation into different

activities and skill categories is endogenous.

v. The dynamic calibration must reproduce the restructured Nepal SAM 2006.

4.1. Additional variables, parameters and equations in dynamic model

We add five additional endogenous variables and five additional equations in the dynamic model on top of the static model.

additional variables:

GRIV	annual growth rate of gross fixed capital formation
LTLR	long-term projected ratio of labour by skill categories
QFS('LSL')	total quantity of low skilled labour
QFS('HSL')	total quantity of high skilled labour
QFS('CAP')	total quantity of capital

In fact, the last three variables are the same as they were used in the static model; rather they were exogenous in the static model but became endogenous in the dynamic model. The dynamic model also contains some additional parameters:

ζ	rate of depreciation
ς	calibration constant in labour supply equation
ξ_1	share of the education cost for low skilled labour borne by the user
ξ_2	share of the education cost for high skilled labour borne by the user
ψ_1	education cost for the low skilled labour
ψ_2	education cost for the high skilled labour
η	education cost exponent parameter
τ	distribution parameter of the present skill ratio to the future skill ratio
$\hbar$	annual growth rate of labour.

Additional equations

1. Annual growth rate of total gross fixed capital formation

Here we assume a constant growth rate of the gross fixed capital formation (GRIV).

$$GRIV = \left(\frac{GFCF}{GFCF_0} \right)^{\frac{1}{t}} - 1 \qquad \text{(i)}$$

where t is the number of year, we have considered it to be 10 years. $GFCF_0$ is the static benchmark value (1996) of the total gross fixed capital formation. Therefore, we will get the value of the capital stock for the year 2006 using the annual growth rate of GFCF equal to GRIV.

2. Total quantity of capital in t^{th} year

$$QFS(CAP) = QFS(CAP)_0(1-\zeta)^t + GFCF_0\sum_{i=1}^{t}(1-\zeta)^{t-i}(1+GRIV)^i \qquad \text{(ii)}$$

$QFS(CAP)_0$ refers to the quantity of capital in the base year 1996. Two factors play determinant role here in estimating the capital stock, the rate of depreciation and the growth rate of capital. They reduce and increase the level of capital stock, respectively. Equation ii calculates the net growth of capital stock as a resultant effect of these two forces.

3. Total supply of labour by skill categories

$$\text{QFS(LSL)} = \left[QFS(LSL)_0 + QFS(HSL)_0\right](1+\hbar)^t - QFS(HSL) \qquad \text{(iii)}$$

where $QFS(LSL)_0$ and $QFS(HSL)_0$ respectively refer to the number of low-skilled and high-skilled labour force for the base year 1996. Here, we assume that the composite labour force, decomposed into high-skilled and low-skilled types, grows at an annual rate of $\hbar$. The basis of the decomposition is given by equation iv.

4. Long-term ratio of labour quantities by skill categories

The long-term division of labour into skill categories depends on their corresponding wage rates (WF), cost of education (ψ_i) and the share of it the individual beneficiary has to bear (ξ_i).

$$LTLR = \frac{QFS(LSL)_T}{QFS(HSL)_T} = \varsigma\left[\frac{\frac{WF(LSL)}{(\xi_1.\psi_1)}}{\frac{WF(HSL)}{(\xi_2.\psi_2)}}\right]^{\eta} \qquad \text{(iv)}$$

For the labour market, total labour force grows at a constant rate ($\hbar$) as shown in equation iii. This growth rate has been made exogenous in this model.

Distribution of labour over both skill types changes endogenously. The workers' choice between low-skilled and high-skilled employment depends on the relative wages and relative education costs. The notation T refers to long term and ς is a calibration constant.

Education and skill differences are the major causes of inequality in wage/income distribution, Lofgren et al. (1999), p. 4. In most of the developing countries, these differences also cause the rural-urban income inequalities, Karshenas (1994). The Nepal SAM 1996 is also evident that rural poor households mainly draw their livelihood from unskilled labour, whereas the urban and non-poor households draw it from the skilled labour and capital rental. Therefore, without skill-upgrade of labour from poorer households, it is very difficult to restructure the economy in favour of these poor.

Equation iv elaborates how labour ratio by skill category adjusts in the long run along with wage ratio and the cost of education ratio. However, these adjustments are not made instantaneously in the short run. There are many factors behind it, most importantly, the imperfect information on wages and restrictions on free access to education, and the gestation lag between entry and the graduation with a high skill. These factors have been captured by equation iv. The equation is obtained by calibration which approximates the movement towards the long-term ratio between the labour supplies by skill categories. The calibration reflects the rationale behind the decision-making and the involved lags.

5. Allocation of labour by skill categories

The ratio of labour by skill categories for the year t can be determined as a weighted average of the ratio in the base year and the ratio in the long run.

$$QFS(LSL)_t = \left[(1-\tau)\left(\frac{QFS(LSL)_0}{QFS(HSL)_0} \right) + \tau . \frac{QFS(LSL)_T}{QFS(HSL)_T} \right] QFS(HSL)_t \qquad (v)$$

where τ is the distribution parameter of the present skill ratio to the future skill ratio.

6. Working of the dynamic model

The working of the dynamic model differs with the static model in two respects. In the first place, the factors are modelled with motion equations. Their values after 10 years are determined with the help of the five equations given above. The first two equations calculate the capital stock; whereas the last three calculate the number of labour by skill categories. In the second place, it requires the scaling-up of all the variables used in the static model. This we do with the help of a new social accounting matrix. The construction of new SAM is based on the sectoral growth rates of different sub accounts. We considered this approach of using new SAM a better option for the dynamic model as compared to others because this requires complete set of balanced data so that we can make a reliable prediction to all the simulations in connection with dynamic CGE.

As we envisage the results for the year 2006 (based on simulation from the dynamic framework), we have developed Nepal SAM 2006 to work as a new baseline dynamic equilibrium. The underlying assumptions behind the dynamic model have been already described at the beginning of section 4. The following section explains the procedure for the construction of new SAM 2006 for Nepal.

4.2. Construction of Nepal SAM 2006

As mentioned earlier, this section presents a hypothetical but plausible SAM 2006 that is used for calibrating the dynamic Nepal CGE model. While preparing the Nepal SAM 2006 starting from the SAM 1996, we made the following procedure to get the consistent macro-SAM and a disaggregated SAM 2006. In the first round of reconstructing the macro-SAM, we upgrade the accounts and

incorporate some restructurings relating to efficiency gains in activities. In the second round, while disaggregating the macro SAM, we assume a redistribution of investment in favour of the poorer groups and make slight changes in the factor and income distribution structure among the households.

With respect to the first round, we did the followings and obtained the results in the form of the macro-SAM as given in Table 7.

i. Annual rate of inflation has been around 5%. All current year values for the SAM 2006 have been deflated by the same figure.

ii. We considered the investment in agriculture should go up on top of the general trend that would be conducive to the restructured model economy benefiting the poor. We have made 1.5% additional investment in agriculture and 0.5% additional investment in industries, which has a strong input-output linkage with the agriculture.

iii. To enhance the efficiency in production activities, we increase the factor share in activities. Factor input as a proportion of the total activities have increased from 0.60 to 0.64 reflecting the higher efficiency in a restructured economy. Intermediate deliveries as a proportion of the total activities have declined from 0.30 to 0.27.

With respect to the second round restructuring, we did the followings:

i. In obtaining the disaggregated macro-SAM 2006, we took the distribution pattern of income-expenditure blocks of different sub-accounts in SAM 1996, see Acharya (2006), as a reference point but incorporated a restructuring of endowments of the lower income population groups who work mostly in agriculture towards the faster growing sectors so that they would benefit from the envisaged greater investment in agriculture and industries. Furthermore, the upgrading of human capital from low to high skill will also benefit the poorer groups and promote their greater participation in the labour force.

ii. In the factor market, the wage share in total value added is slightly increased at the cost of profit share. These adjustments take the form of a premium of 3% growth in the total share of low-skilled wage earning, 1.5% growth in the total share of high-skilled wage earning, and around 4.5% decline in the total share of profit. This decline in the profit share is approximated by 1.5% e from each household category except from landless rural households. The landless rural households have a very little share of profit in their incomes.

iii. These adjustments of wage and profit shares were carried further to the activity account. The public service sector being a highly labour intensive is kept in its original factor distribution patterns. In the cases of agriculture, industry, and commercial services, we applied a 3% increase in low-skilled wage earning, 1.5% to the high-skilled wage earning and around 4.5% decline in the profit share.

iv. For the other accounts, the distributions follow the same pattern of the 1996 SAM.

v. The imbalances are rebalanced via rational adjustments in the respective accounts aiming at minimising the deviations from the inserted levels.

vi. Contribution by the foreign saving has been taken as a residual to balance the rest of the world account and the national capital account.

The implementation of the above procedures leads to Nepal SAM 2006 representing a restructured and plausible economy; see Table 7.

5. Simulation in dynamic model

The way our simulation works in Nepal CGE model has already been explained in Section 3. Here, we limit our explanation to the results which are different from the simulation in static model.

Table 7: Disaggregated social accounting matrix of Nepal 2006 (plausible restructured economy) (values in million Rupees, 1996 price level)

	Activities				Commodities				Factors			Households				FIRMS	GOV	S-I	YTAX	STAX	TAR	ROW	Total
	AGR-A	IND-A	CS-A	OS-A	AGR-C	IND-C	CS-C	OS-C	WLSL	WHSL	PROFIT	U-HH	LR-HH	SR-HH	LLR-HH								
AGR-A					181249																		181249
IND-A						169308																	169308
CS-A							142195																142195
OS-A								57374															57374
AGR-C	19901	28482	18	98								33722	16180	45722	32218			18873				6504	201720
IND-C	302	30053	6238	5903								14610	11060	24970	11619			62915				38003	205673
CS-C	11688	6630	20427	7170								37160	12763	17243	8827			25558				17958	165424
OS-C	1048	3521	6952	1613								8204	4922	7815	8032		35323	4070				0	81500
WLSL	65578	23094	32162	19906																			140740
WHSL	10754	14081	6861	16388																			48085
PROFIT	60747	40879	61499	2673																			165799
U-HH									37574	19125	46902						494					575	104670
SR-HH									47787	9262	42220						2204					1263	102736
LR-HH									23692	12346	34730						435					514	71717
LLR-HH									31687	7352	18490						2066					2683	62279
FIRMS									0	0	23457						9901						33358
GOV																			16203	13893	11286	10698	52079
S-I												7052	23350	6986	1582	24518	1656					46271	111416
YTAX												3921	3442	0	0	8840							16203
STAX					2719	7111	2977	1086															13893
TAR					2070	2732	2580	3904															11286
ROW	11230	22568	8038	3622	15682	26522	17671	19136															124469
Total	181249	169308	142195	57374	201720	205673	165424	81500	140740	48085	165799	104670	71717	102736	62279	33358	52079	111416	16203	13893	11286	124469	

Note: The factor account has been divided into three main accounts namely, unskilled labour, skilled labour, and capital (including land). Their rates of remunerations have been noted by WLSL, WHSL, and PROFIT, respectively. The current accounts of institutions have been categorised into three main sub-accounts: households, firms, and government. Moreover, the household account has been further divided into four different types: urban households, large rural households, small rural households, and land-less rural households, (U-HH, LR-HH, SR-HH, and LLR-HH, respectively). This sub-division of households is based on various socio-economic characteristics, regional attributes and other endowment characteristics applicable to Nepal. The first two groups (U-HH and LR-HH) are rich households whereas the latter two (SR-HH and LLR-HH) are poor household groups. Among the poor, LLR-HH is the poorest. There is an aggregate capital account (national accumulation) for all institutions taken together. The activity account comprises four major sub-accounts: agriculture, industry, commercial services, and other services (AGR-A, IND-A, CS-A, and, OS-A, respectively). A similar pattern (AGR-C, IND-C, CS-C, and OS-C, respectively) is followed in case of the commodity account.

Activity price index (PA) for public services goes down from 1 to 0.98 as compared to 1.002 in case of static model. But value added price (PVA) of public services does not change in this simulation as compared to its rise in static model simulation. Public service activities grow by 0.35% in dynamic simulation as compared to the contraction by 0.8% in the static model. Likewise, agricultural and industrial activities grow more and commercial services contract less in dynamic simulation as compared to the static simulation. Similar implication is on domestic supply of domestic output (QD), quantity of imports (QM), and composite supply of commodities (QQ).

GDP grows at the rate of 1.64% in the dynamic model simulation as compared to 0.58% in the static one. Due to the overall growth in economic activities, government revenue rises more with further decline in budget deficit. Budget deficit to public expenditure ratio declined to 0.23 in dynamic simulation from 0.31 in static simulation. Likewise, foreign capital inflow grows by 2.39% when compared with 0.86% in static simulation. Most importantly, we observe remarkable changes in the growth of household incomes between these two simulations. In static model, one of the rich household groups, large rural households (LR-HH), benefits the most whereas the growth rate of income of the poorest household group, landless rural household group (LLR-HH), is almost equal to the national average (Table 8). However, in the restructured model economy, the poorest household group is benefiting the most. The same degree of import liberalisation raises the household income of this group by 2.19% against the national average of 1.64%. Likewise, the second poor household group, small rural households (SR-HH), also benefits with 1.87% growth in their income that is more than that of the rich household groups'. As the later also benefit from higher household income, none of the household groups loses from import liberalisation. It shows the mode of restructuring done is essential for the pro-poor growth.

Table 8: Growth of household income under static and dynamic simulations

Household type	% change in household income from the respective baseline	
	Static model (1996)	Dynamic model (2006)
Urban Household (U-HH)	0.52	1.19
Large Rural Households (LR-HH)	0.70	1.50
Small Rural Households (SR-HH)	0.65	1.87
Landless Rural Households (LLR-HH)	0.63	2.19
All Nepal	0.62	1.64

There are two more conditions to realize these changes. First, ratio of the quantity of high-skilled labour to low-skilled labour (LTLR) must have increased from 4.54 in the baseline to 4.62 in 2006. Furthermore, gross fixed capital formation requires to grow annually by 5.8%.

6. Conclusion

The comparison between dynamic and static model simulations reveals that there are possible avenues

to the developing and transition economy to generate higher and pro-poor growth. The whole thrust of this generation of higher and pro-poor growth rests on the way the economy is restructured. For the transition and developing economy of Nepal, it requires the improvement of distribution and efficiency parameters. In our Nepal dynamic CGE model, the distribution parameters have slightly changed in favour of labour specifically to low-skilled labour working in agriculture and industry. As a result, this change benefits the landless rural households most, which is the poorest one among the four household groups. Next to the landless rural households, the benefit goes to the small rural households, which is the second poorest household group. However, none of the richer household groups, urban households and large rural households, experience a loss in household income. They also get benefited but less than the poor household groups. This confirms the import liberalisation favouring the poor in the framework of restructured economy.

Following our analysis, another condition for the higher and pro-poor growth is the efficiency gain in activities. In the dynamic Nepal CGE, it is well reflected by the reduction in intermediate deliveries and intermediate import per unit of activity. It has paved the way for the use of more factor inputs in activities which eventually benefits households and firms who supply factors of production. Some other important changes are also prominent in the dynamic model. Growth of the inflow of foreign capital is distinctly higher in the dynamic simulation over the static one. It has become a part and parcel of a fast growing economy in its take-off phase. Budget deficit, on the other, narrows down in the restructured economy. This contraction in the fiscal deficit has become possible by the higher growth of the economic activities and institutional incomes so that government can collect more tax revenues.

Analysing the results of the static and dynamic simulations shows that marginal increase in the labour participation rate in the dynamic model can bring some of the contracting activities in the short-run under expansion in the long-run. Public services activities reveal this prospect. Next to the high growth sectors such as industry and agriculture, inflow of more labour in the labour market would go to public services, which is a highly labour intensive sector in the case of Nepalese economy. It presses the wage rate of low-skilled labour marginally downward because the new entrants are mostly low-skilled. Moreover, it causes some of the low-skilled labour transfer to the high-skilled category. The capital stock also grows at a higher rate to absorb the growing labour force. This growth dynamics is very important in leading the economy in the higher growth path in the long run. But, there should be supportive policies in the economy to materialise this prospect. First, the investment in agriculture must go up to absorb this increasing low-skilled labour force because agriculture is the main activity that employs a majority of the low-skilled labour in Nepal. Second, the modern sector of the economy -- industry and commercial services -- should also be able to absorb some of the new

entrant labours in the course of expansion. We have included both of these prospects while making the restructured economy in the form of SAM 2006. On the one hand, the investment in agriculture has been scaled up from its normal trend.

Another important change we made in the dynamic model is the distribution pattern of endowments. Poorer households earn more from the highly growing sectors such as industry and agriculture while factor income of the richer household categories comes more from the slow growing services sectors. The effective public policy to this end is the promotion of landless rural households to have more access to skill trainings pertaining to agricultural and agro-based industrial activities so that they will gradually shift to these growing activities. Next to this, promotion of the small rural household category, which is also poor next to the landless group, is necessary to invest its capital in agriculture and agro-based industries so that they could also enjoy with the higher growth of these two sectors. The government is required to provide some incentives to this household group to invest its capital in agriculture and industry although this group possesses limited capital. The large rural household group would definitely benefit to some extent by the growing agriculture sector. The benefit to the richest households, urban household group, only comes from the higher rate of wage to high skilled workers and profit to invested capital.

To summarise, there are conditions necessary for combining a higher pro-poor growth with import liberalisation for a developing transition economy. To meet this end, this study recommends the followings. The economy should identify the sectors that have high growth potential in the course of globalisation, more specifically in trade liberalisation. The targeted poor group must be encouraged to participate in those fastest growing activities with the factors they have at their disposal, in most of the cases the low-skilled labour. The provision of skill training pertaining to the employment in the high growth sectors is expected to promote labour transfer. Credit incentive would also be another factor to promote poor to invest in the high growth sectors provided that the poor also possess financial capital. Moreover, employment promotion schemes should complement the liberalisation process so that new entry of low-skilled labour would raise the wage rate of high skilled labour and rate of return to capital. It raises the incentive to low-skilled labour to get transformed to the high skilled worker. This scheme, in fact, pushes the economic system in motion and leads towards the high growth of the economy in the long run as the quality of factors get improved over time. Moreover, when public policy becomes able to redirect the factor endowments of the poor into the most growing sectors, the high growth attained also becomes a pro-poor growth.

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APPENDIX A1: Model notations and equations

Notations

Sets

$a \in A$ activities (agriculture, industry, commercial services, other services)
$c \in C$ commodities (agriculture, industry, commercial services, other services)
$c \in CM (\subset C)$ imported commodities
$c \in CNM (\subset C)$ non-imported commodities
$c \in CE (\subset C)$ exported commodities
$c \in CNE (\subset C)$ non-exported commodities
$f \in F$ factors (low skilled labour, high skilled labour, capital)
$h \in H (\subset I)$ households (UHH, LRHH, SRHH, LLRHH)
$i \in I$ institutions (households, government, firms)
r ∈ rest of the world

Parameters

ad_a	production function calibration parameter
aq_c	shift parameter for composite supply (Armington) function
at_c	shift parameter for output transformation (CET) function
ica_{ca}	quantity of c as intermediate input per unit of activity a
aps_h	share of disposable household income to savings
$apsf$	share of disposable firms' income to savings
$qinsh_c$	share of investment goods in different commodity markets
$chsts_c$	share of the change in stock in different commodities
$shry_{h,fa}$	share of household h in the income of factor f in activity a
$shry_{fi}$	share of factor income going to firms
te_c	export tax rate
tm_c	import tariff rate
tq_c	sales tax rate
tr_{ii}'	transfer from institution i' to institution i
ty_h	rate of household income tax
α_{fa}	value-added share for factor f in activity a
β_{ch}	share of commodity c in the consumption of household h
δ_c^q	share parameter for composite supply (Armington) function
δ_c^t	share parameter for output transformation (CET) function
θ_{ac}	yield of commodity c per unit of activity a
ρ_c^q	exponent ($-1 < \rho_c^q < \infty$) for composite supply (Armington) function
ρ_c^t	exponent ($1 < \rho_c^t < \infty$) for output transformation (CET) function
ec_c	export calibration constant
eec_c	export elasticity constant
im_c	import calibration constant
ime_c	import elasticity coefficient
$ncir_{ra}$	non competitive import coefficient from ROW to activities
tyf	rate of income tax to firms
ε_0	private investment calibration constant
?	public investment exponent parameter
φ	profit rate exponent parameter
nd_{llr}	number of dependents per land-less household worker

Variables	
GE	government expenditure
GS	government budget deficit/surplus
GI	public investment
GC_c	quantity of government demand for commodity *c*
GY	government revenue
EXR	foreign exchange rate (domestic currency per unit of foreign currency)
FSAV	foreign savings
GFCF	gross fixed capital formation in the economy
CHST	total change in the stock in the economy
PA_a	activity price
PD_c	domestic price of domestic output
PE_c	export price (domestic currency)
PM_c	import price (domestic currency)
PQ_c	composite commodity price
PVA_a	value-added price
PX_c	producer price
PWE_c	export price (foreign currency)
PWM_c	import price (foreign currency)
QA_a	activity level
QD_c	quantity of domestic output sold domestically
QE_c	quantity of exports
QF_{fa}	quantity demanded of factor *f* by activity *a*
QFS_f	supply of factor *f*
QH_{ch}	quantity of consumption of commodity *c* by household *h*
$QINT_{ca}$	quantity of intermediate use of commodity *c* by activity *a*
$QINV_c$	quantity of investment demand
QM_c	quantity of imports
QQ_c	quantity supplied to domestic commodity demanders (composite supply)
QX_c	quantity of domestic output
TR_{hg}	transfer to household from government
TR_{hr}	transfer to household from rest of the world
TR_{gr}	transfer to government from rest of the world
$TR_{fi,g}$	transfer to firms from the government
WF_f	average wage (rental rate) of factor *f*
YF_{fa}	remuneration of factor *f* in activity *a*
YH_h	income of household group *h*
YFF	income of firms from factors
YFIR	total income of firms
GDP	Gross Domestic Product of the economy
PCI_{llr}	per capita income of the land-less rural household
PCIN	per capita income in Nepal
TP	total population in Nepal

Model Equations

Price block

$PM_c = (1 + tm_c) \cdot EXR \cdot PWM_c$ — $c \in CM$ ……(1)

$PE_c = (1 - te_c) \cdot EXR \cdot PWE_c$ — $c \in CE$ ……(2)

$PQ_c \cdot QQ_c = PD_c \,.\, QD_c \,.(1 + tq_c) + PM_c \cdot QM_c$ — $c \in C$ ……(3)

$PX_c \cdot QX_c = PD_c \cdot QD_c + (PE_c \cdot QE_c)$ — $c \in C$ ……(4)

$PA_a = \sum_{c \in C} PX_c . \theta_{ac}$ — $a \in A$ ……(5)

$PVA_a = PA_a - \sum_{c \in C} PQ_c \cdot ica_{ca} \;\; - ncir_{ra} \;\; . PA_a$ — $a \in A$ ……(6)

Production and commodity block

$QA_a = ad_a \cdot \prod_{f \in F} QF_{fa}^{\alpha_{fa}}$ — $a \in A$ ……(7)

$$WF_f = \frac{\alpha_{fa} . PVA_a . QA_a}{QF_{fa}}$$ — $f \in F, a \in A$ ……(8)

$QINT_{ca} = ica_{ca} \cdot QA_a$ — $c \in C, a \in A$ ……(9)

$QX_c = \sum_{a \in A} \theta_{ac} \cdot QA_a$ — $c \in C$ ……(10)

$$QQ_c = aq_c . (\delta_c^q QM_c^{-\rho_c^q} + (1 - \delta_c^q) . QD_c^{-\rho_c^q})^{\frac{-1}{\rho_c^q}}$$ — $c \in C$ ……(11)

$$\frac{QM_c}{QD_c} = im_c \left[\left(\frac{PD_c}{PM_c} \right)^{ime_c} . \frac{\delta_c^q}{1 - \delta_c^q} \right]^{\frac{1}{1+\rho_c^q}}$$ — $c \in CM$ ……(12)

$$QX_c = at_c . (\delta_c^t . QE_c^{\rho_c^t} + (1 - \delta_c^t) . QD_c^{\rho_c^t})^{\frac{1}{\rho_c^t}}$$ — $c \in CE$ .....(13)

$QX_c = QD_c$ — $c \in CNE$ .....(13.1)

$$\frac{QE_c}{QD_c} = ec_c \left[\left(\frac{PE_c}{PD_c} \right)^{eec_c} . \frac{1 - \delta_c^t}{\delta_c^t} \right]^{\frac{1}{\delta_c^t - 1}}$$ — $c \in CE$ ……(14)

Institution block

$YF_{fa} = QF_{fa} . WF_f$ — $a \in A, f \in F$ ……(15)

$YH_h = \sum_{fa} shry_{h,fa} . YF_{fa} + TR_{hg} + EXR . TR_{hr}$ — $a \in A, h \in H, f \in F$ ...(16)

$$QH_{ch} = \frac{\beta_{ch} . (1 - aps_h) . (1 - ty_h) . YH_h}{PQ_c}$$ — $c \in C, h \in H$ ……(17)

$YFF = shry_{fi} . \sum_{a \in A} QF_{fa} \,.\, WF_f$ — $f \in F, a \in A$ ……(18)

$YFIR = YFF + TR_{fi,g}$ — ……(19)

$GFCF = GI + \varepsilon_0 (GI)^{\mu} (WF_{cap})^{\phi}$ — $WF_{cap} \in WF(F)$. .....(20)

$$QINV_c = \frac{qinsh_c . GFCF}{PQ_c}$$ — $c \in C$ ……(21)

$GY = \sum_{h \in H} ty_h \cdot YH_h + \text{tyf.YFIR} + \sum_{c \in C} tq_c \cdot (PD_c \cdot QD_c) +$

$$\sum_{c \in CM} tm_c \cdot EXR \cdot PWM_c \cdot QM_c + EXR \cdot TR_{gr} \qquad c \in C, h \in H \ldots\ldots\ldots(22)$$

$$GE = \sum_{c \in C} PQ_c \,.\, GC_c + \sum_{h \in H} TR_{hg} + TR_{fi,g} + GI \qquad c \in C, h \in H \ldots\ldots\ldots(23)$$

$$GS = GY - GE \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(24)$$

$$PCI_{llr} = \frac{YH_{llr}}{\dfrac{\sum_{fa} shry_{llr.fa} . YF_{fa}}{WF_f} . nd_{llr}} \qquad f \in F, a \in A \ldots\ldots\ldots(25)$$

$$PCIN = \frac{\sum_{h} YH_h}{TP} \qquad h \in H \ldots\ldots\ldots\ldots\ldots(26)$$

$$GDP = \sum_{a \in A} PVA_a . QA_a \qquad a \in A \ldots\ldots\ldots\ldots\ldots(27)$$

System constraints block

$$\sum_{a \in A} QF_{fa} = QFS_f \qquad f \in F, a \in A \ldots\ldots\ldots(28)$$

$$QQ_c = \sum_{a \in A} QINT_{ca} + \sum_{h \in H} QH_{ch} + GC_c + QINV_c + chsts_c . CHST / PQ_c \qquad a \in A, h \in H, c \in C. (29)$$

$$\text{FSAV} = \sum_{c \in C} PWM_c \cdot QM_c + \sum_{a \in A} (PA_a \cdot ncir_{ra} . QA_a)/EXR - \sum_{c \in C} PWE_c \cdot QE_c - \sum_{i \in I} TR_{ir}$$

$$c \in C, i \in I \ldots\ldots\ldots\ldots(30)$$

$$\sum_{h} YH_h . aps_h . (1-ty_h) + YFIR . apsf . (1-tyf) + (GY-GE) + FSAV . EXR =$$

$$\sum_{c} PQ_c . QINV_c + WALRAS \qquad h \in H, c \in C \ldots\ldots\ldots(31)$$

$$\sum_{c \in C} PQc \cdot cwts_c = CPI \qquad c \in C \ldots\ldots\ldots\ldots\ldots(32)$$

APPENDIX A2: Changes in the values of parameters between 1996 and 2006 models

Table A2.1: Share of income by factor and activity going to households ($shry_{hf}$) and firms (shryf)

Household and firms	Factor incomes from											
	LSL in activities				HSL in activities				Capital in activities			
	AGR	IND	CS	OS	AGR	IND	CS	OS	AGR	IND	CS	OS
U-HH	0.11	0.11	0.11	0.11	0.11	0.38	0.19	0.18	0.19	0.64	0.52	1.00
LR-HH	0.10	0.10	0.10	0.10	0.10	0.10	0.16	0.17	0.60	0.11	0.16	0.00
SR-HH	0.40	0.40	0.40	0.40	0.40	0.41	0.65	0.65	0.21	0.09	0.06	0.00
LLR-HH	0.38	0.38	0.38	0.38	0.38	0.11	0.00	0.00	0.00	0.00	0.00	0.00
FIRM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.26	0.00

Table A2.2: Share of income by factor and activity going to households ($shry_{hf}$) and firms (shryf)

Household and firms	Factor incomes from											
	LSL in activities				HSL in activities				Capital in activities			
	AGR	IND	CS	OS	AGR	IND	CS	OS	AGR	IND	CS	OS
U-HH	0.16	0.20	0.56	0.24	0.12	0.33	0.63	0.54	0.10	0.40	0.36	1.00
LR-HH	0.17	0.16	0.19	0.16	0.28	0.24	0.15	0.31	0.29	0.10	0.21	0.00
SR-HH	0.46	0.19	0.15	0.42	0.33	0.12	0.21	0.15	0.31	0.32	0.17	0.00
LLR-HH	0.22	0.45	0.11	0.18	0.28	0.31	0.00	0.00	0.30	0.00	0.00	0.00
FIRM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.26	0.00

Table A2.3: Factor shares (α_{fa}) and calibration constant (ad_a) in production function (2006)

parameters	activities			
	AGR-A	IND-A	CS-A	OS-A
factor share (α_{fa})				
low skilled labour wage (LSLW)	0.478 (0.440)	0.296 (0.206)	0.320 (0.257)	0.511 (0.530)
high skilled labour wage (HSLW)	0.078 (0.084)	0.180 (0.178)	0.068 (0.080)	0.421 (0.401)
profit	0.443 (0.476)	0.524 (0.616)	0.612 (0.663)	0.069 (0.069)
calibration constant (ad_a)	277.169 (193.231)	214.407 (83.078)	42.663 (25.830)	22442.18 (19443.181)

Note: Figures in the parentheses in this and following tables represent the values for static model of 1996.

Table A2.4: Quantities of commodities as intermediate inputs per unit of activity (ica_{ca}) (2006)

commodities/services	activities			
	AGR-A	IND-A	CS-A	OS-A
AGR-C	0.108 (0.119)	0.166 (0.176)	0.0001 (0.001)	0.002 (0.002)
IND-C	0.002 (0.002)	0.170 (0.181)	0.042 (0.045)	0.099 (0.112)
CS-C	0.063 (0.069)	0.038 (0.041)	0.141 (0.151)	0.122 (0.139)
OS-C	0.006 (0.006)	0.020 (0.022)	0.048 (0.051)	0.028 (0.031)

Table A2.5: Market interaction relating to commodities (2006)

parameters	commodities			
	AGR-C	IND-C	CS-C	OS-C
import share of composite commodity (δ_c^q)	0.08 (0.06)	0.16 (0.16)	0.12 (0.13)	0.24 (0.25)
export share of composite commodity (δ_c^t)	0.04 (0.05)	0.23 (0.28)	0.13 (0.16)	-
function shift parameter for supply of c (aq_c)	1.26 (1.20)	1.67 (1.66)	2.503 (2.48)	2.21 (2.21)
armington function shift parameter for demand of c (at_c)	1.06 (1.08)	1.48 (1.63)	1.25 (1.32)	-
non-competitive import coefficient ($ncir_a$)	0.06 (0.08)	0.13 (0.16)	0.06 (0.07)	0.06 (0.08)
import calibration constant (im_c)	5.47 (5.30)	0.72 (0.77)	0.28 (0.33)	0.49 (0.55)
export calibration constant (ec_c)	0.0001 (0.0001)	0.03 (0.06)	0.003 (0.01)	0.0 (0.0)
weights in the cpi ($cwts_c$)	0.43 (0.43)	0.21 (0.21)	0.26 (0.26)	0.1 (0.1)
share of investment ($qinsh_c$)	0.17 (0.15)	0.57 (0.56)	0.23 (0.25)	0.04 (0.04)